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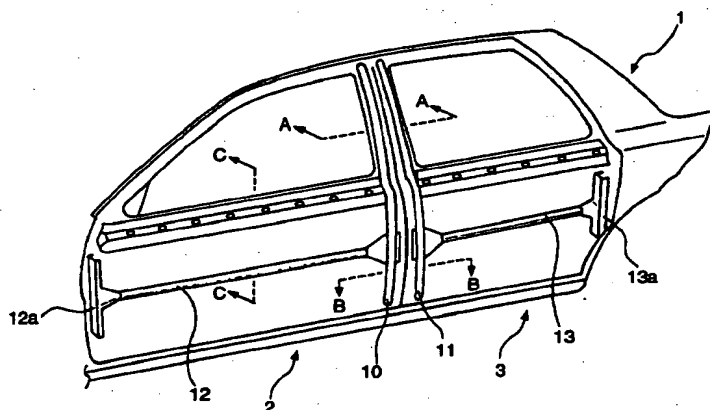
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### (54) Side door structure for vehicle

(57) Double-leafed hinged door type front and rear doors do not have a center pillar in a side opening. In order that one can open and close the front and rear doors independently of each other and in order to protect passengers by absorbing any impact caused by

side collision, reinforcing members (10, 11) obtained from high tensile steel by hydroforming are provided near joint surfaces of the front door (2) and rear door (3) provided to the side opening of a car body (1).

**FIG. 3**



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belt line member is fixed to the reinforcing member.

[0011] The side door structure for a vehicle is also characterized in that a ceiling cross member obtained from high tensile steel by hydroforming is provided to a ceiling of the car body to extend in a widthwise direction of the car body, and an upper end of the reinforcing member overlaps an end face of the ceiling cross member.

[0012] The side door structure for a vehicle is also characterized in that a floor surface cross member obtained from high tensile steel by hydroforming is provided to a floor surface of the car body to extend in a widthwise direction of the car body, and a lower end of the reinforcing member overlaps an end face of the floor surface cross member.

[0013] The side door structure for a vehicle is also characterized in that hollow portions of the reinforcing member, ceiling cross member, and floor surface cross member are filled with a filler.

[0014] The side door structure for a vehicle is also characterized by comprising door handles respectively provided to the front and rear doors, locking means for unlocking the front and rear doors upon operation of the door handles, front strikers provided to upper and lower edges of the side opening at substantially central portions, and rear strikers provided behind the front strikers, wherein the locking means are operated independently of each other to allow the front and rear doors to be openable and closeable independently of each other. The side door structure for a vehicle is also characterized in that the front and rear strikers are fixed by using plate members.

[0015] As described above, according to the invention described in claim 1, in a side door structure for a vehicle, comprising a front door having a front end openably/closeably supported by a front hinge disposed at a front portion of a side opening of a car body, and a rear door having a rear end openably/closeably supported by a rear hinge disposed at a rear portion of the side opening, a reinforcing member obtained from high tensile steel by hydroforming is fixed to one or both of the front and rear doors along joint surfaces of the front door and the rear door in a vertical direction. Therefore, when using double-leafed hinged door type front and rear doors without a center pillar in the side opening, the front and rear doors can be opened/closed independently of each other, and the reinforcing members having a complicated shape can be provided near the joint surfaces of the front and rear doors. Hence, a sufficiently large car body rigidity can be ensured.

[0016] According to the invention described in claim 2, a side impact bar is provided to one or both of the front door and the rear door in a back-and-forth direction of the car body, and an end of the side impact bar is fixed to the reinforcing member. Therefore, in the case of side collision, another vehicle bores the car compartment less, so passengers can be protected.

[0017] According to the invention described in claim

3, a belt line member is provided to one or both of the front door and the rear door in a back-and-forth direction of the car body, and an end of the belt line member is fixed to the reinforcing member. Therefore, the degree with which another vehicle bores the car compartment of a vehicle in the case of side collision can be further reduced.

[0018] According to the invention described in claim 4, a ceiling cross member obtained from high tensile steel by hydroforming is provided to a ceiling of the car body to extend in a widthwise direction of the car body, and an upper end of the reinforcing member overlaps an end face of the ceiling cross member. Therefore, the degree with which another vehicle bores the car compartment of a vehicle at the ceiling portion, in the case of side collision, can be further reduced. According to the invention described in claim 5, a floor surface cross member obtained from high tensile steel by hydroforming is provided to a floor surface of the car body to extend in a widthwise direction of the car body, and a lower end of the reinforcing member overlaps an end face of the floor surface cross member. Therefore, the degree with which another vehicle bores the car compartment of a vehicle at the floor surface, in the case of side collision, can be further reduced.

[0019] According to the invention described in claim 6, hollow portions of the reinforcing member, ceiling cross member, and floor surface cross member are filled with a filler, so that the strength can be further increased.

[0020] According to the invention described in claim 7, the side door structure for a vehicle is also characterized by comprising door handles respectively provided to the front and rear doors, locking means for unlocking the front and rear doors upon operation of the door handles, front strikers provided to upper and lower edges of the side opening at substantially central portions, and rear strikers provided behind the front strikers, wherein the locking means are operated independently of each other, so the front and rear doors be opened and closed independently of each other. Therefore, the front and rear doors can be opened and closed independently of each other.

[0021] According to the invention described in claim 8, the front and rear strikers are fixed by using plate members, so that the front and rear doors can be prevented from being unlocked in the case of side collision.

[0022] Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a perspective view of the outer appearance

[0031] Fig. 4 is a perspective view of an outer appearance showing a section taken along the line of arrows A - A of Fig. 3. Fig. 4 typically shows the joint portion of the front and rear doors. Referring to Fig. 4, when the front and rear doors 2 and 3 are closed, a door sash 2a of the front door 2 and a door sash 3a of the rear door 3 are joined as shown in Fig. 4. More specifically, a weather strip 15 is fixed to extend downward from the door sash 2a of the front door 2. Two lips branching from the weather strip 15 butt against the inner and lower sides of the door sash 3a of the rear door 3, thereby providing a good seal.

[0032] Fig. 5 is a sectional view taken along the line of arrows B - B of Fig. 3, and shows the joint portion between the front and rear doors. Referring to Fig. 5, the weather strip 15 described with reference to Fig. 4 is fixed to depend continuously from the door sash 2a of the front door 2, thereby sealing the front and rear doors entirely in the vertical direction.

[0033] When the front door 2 sealed in this manner is simply pivoted open, a force is generated which moves outward the lips of the weather strip 15, which have deformed as they abut against the closed rear door. As a result, the service life of the weather strip is greatly degraded. When the front door is opened or closed, an excessive load is generated by deformation of the weather strip 15, and adversely influences the operability of the door upon opening/closing it. On the other hand, when the rear door 3 is moved to pivot in the direction of an arrow D3, an excessive force that moves the lips of the weather strip 15 outward is not generated.

[0034] Under the circumstance, the front door 2 is opened and closed along a composite track such that after it moves substantially linearly in the direction of an arrow D1, it pivots in the direction of an arrow D2. Hence, a force that moves the lips of the weather strip outward is not generated.

[0035] Fig. 6 is a perspective view showing a section taken along the line of arrows C - C of Fig. 3. As shown in Fig. 6, since the front side impact bar 12 is incorporated in a space between the inner and outer panels, passengers are protected from the impact of side collision. A side window 17 is sandwiched between belt line members to be vertically movable, as shown in Fig. 6.

[0036] Fig. 7 is a perspective view showing a section taken at substantially an intermediate portion between the line of arrows A - A and the line B - B of Fig. 3, and shows the front and rear reinforcing members 10 and 11 (described above) incorporated near the joint surfaces of the front and rear doors. Fig. 8 is a sectional view taken along the line of arrows B - B of Fig. 3. Referring to Figs. 7 and 8, the front and rear reinforcing members 10 and 11 are obtained as hollow members from high tensile steel by hydroforming, as shown in Figs. 7 and 8, and are fixed to the joint surfaces between the front and rear doors 2 and 3 in the vertical direction through fixing brackets 20. Although Figs. 7 and 8 show

a case wherein the front and rear reinforcing members 10 and 11 are fixed to the front and rear doors 2 and 3, a reinforcing member may be provided to only one of the front and rear doors 2 and 3. The reinforcing member 10 has a hole 10a pierced during hydroforming described above. An electrode for spot welding is inserted in the hole 10a, and the bracket 20 is fixed to the reinforcing member 10 by welding it at spot welding portions 21. The bracket 20 fixed in this manner is welded to an inner panel 18 of the door and the side surface of the inner panel 18 at the spot welding portions 21, so that the reinforcing member 10 can be positioned in a space defined by the inner panel 18 and an outer panel 19. Although the reinforcing members 10 and 11 fixed in this manner have complicated shapes, they can be manufactured easily by hydroforming described above.

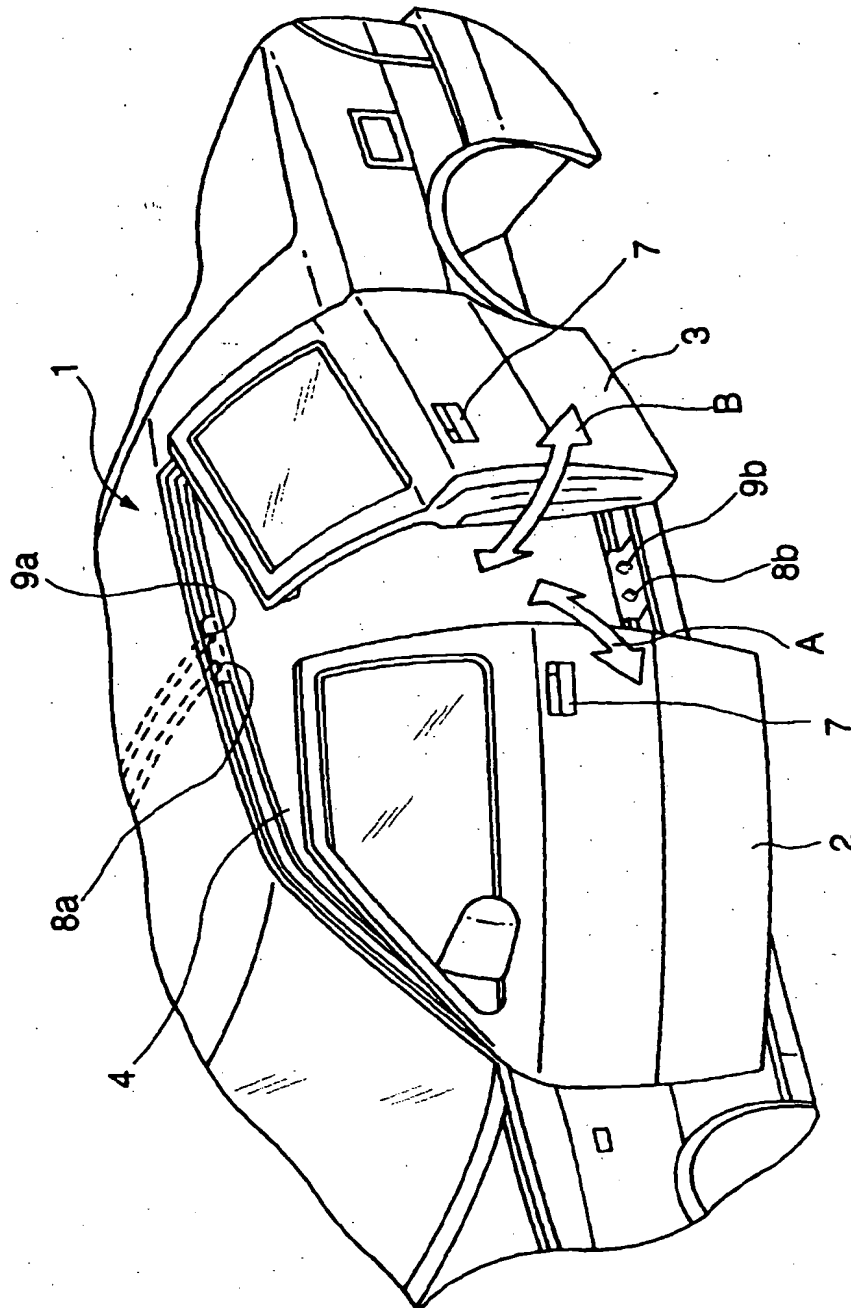
[0037] Fig. 9A is a perspective view of the outer appearance of the reinforcing member 10, and Fig. 9B is a perspective view of the outer appearance showing the bonding portion between the reinforcing member 10 and side impact bar 12. Referring to Figs. 9A and 9B, since the circumferential length of the front reinforcing member 10 manufactured by hydroforming described above cannot be less than the circumferential length of the material, the reinforcing member 10 is formed with a portion 10c where it is bent inward for an amount corresponding to the unnecessary, extra length. The front reinforcing member 10 is recessed midway along it to form a recess 10b, as shown in Figs. 9A and 9B. Therefore, the side impact bar 12 can be welded to the reinforcing member 10. The rear end portion of the front side impact bar 12 is set in this recess 10b, as shown in Fig. 9B, and is welded at a continuous welding portion 22. As a result, the rigidity of the front door is increased, and the car compartment can be effectively prevented from being invaded in the case of side collision. Although not shown, a side impact bar and a rear reinforcing member are fixed to the rear door by welding to increase the strength.

[0038] Fig. 10 is a perspective view of an outer appearance showing the relationship between a locking unit 23 serving as a locking means and a front striker 8b, which are provided at the lower portion of the front door 2, and Fig. 11 is a cross-sectional view of Fig. 10.

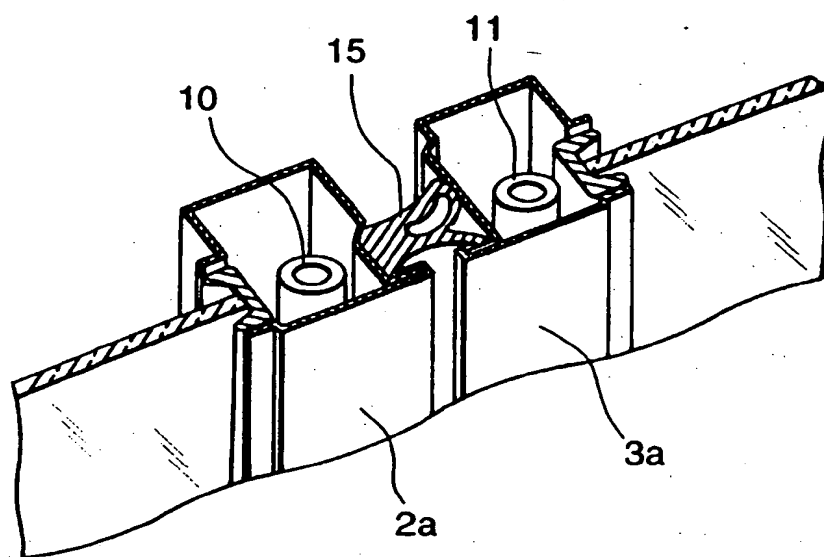
[0039] Referring to Figs. 10 and 11, the constituent components that are already described are denoted by the same reference numerals as those employed above, and a detailed description thereof will be omitted. The front door 2 incorporates the locking unit 23 operated by the door handle 7. In a lower side sill 24 of the car body, a plate member 27 is provided in advance by spot welding at a position corresponding to the front and rear strikers 8b and 9b, and the respective strikers are fixed on the plate member 27 to increase the strength. A floor surface floor panel 25 of the vehicle continues from the lower side sill 24. A floor surface cross member 26 molded by hydroforming described

5. The structure according to claim 1, characterized in that a ceiling cross member (29) obtained from high tensile steel by hydroforming is provided to a ceiling of said car body to extend in a widthwise direction of said car body, and an upper end of said reinforcing member (10, 11) overlaps an end face of said ceiling cross member. 5
6. The structure according to claim 2, characterized in that a ceiling cross member (29) obtained from high tensile steel by hydroforming is provided to a ceiling of said car body to extend in a widthwise direction of said car body, and an upper end of said reinforcing member overlaps an end face of said ceiling cross member. 10 15
7. The structure according to claim 1, characterized in that a floor surface cross member (26) obtained from high tensile steel by hydroforming is provided to a floor surface of said car body to extend in a widthwise direction of said car body, and a lower end of said reinforcing member overlaps an end face of said floor surface cross member. 20
8. The structure according to claim 1, characterized in that a hollow portion of said reinforcing member is filled with a filler. 25
9. The structure according to claim 5, characterized in that a hollow portion of said ceiling cross member is filled with a filler. 30
10. The structure according to claim 7, characterized in that a hollow portion of said floor surface cross member is filled with a filler. 35
11. The structure according to claim 1, characterized by comprising:
  - door handles (7, 7) respectively provided to said front and rear doors, locking means (23) for unlocking said front and rear doors upon operation of said door handles, front strikers (8a, 8b) provided to upper and lower edges of said side opening at substantially central portions, and rear strikers (9a, 9b) provided behind said front strikers, wherein said locking means are operated independently of each other, so said front and rear doors can be opened and closed independently of each other. 40 45 50
12. The structure according to claim 11, characterized in that said front and rear strikers are fixed by using plate members. 55

FIG. 2



**FIG. 4**



**FIG. 6**

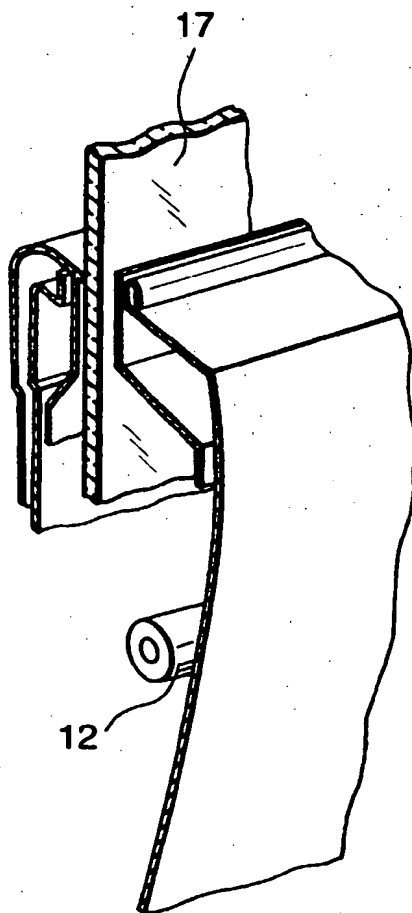


FIG. 8

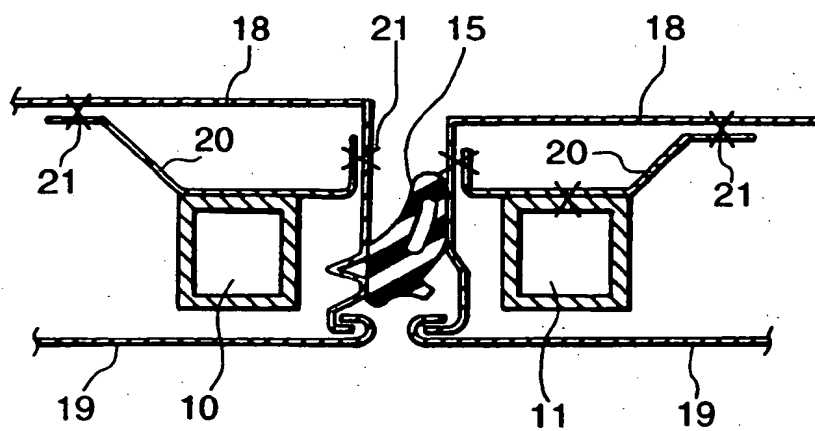




FIG. 10

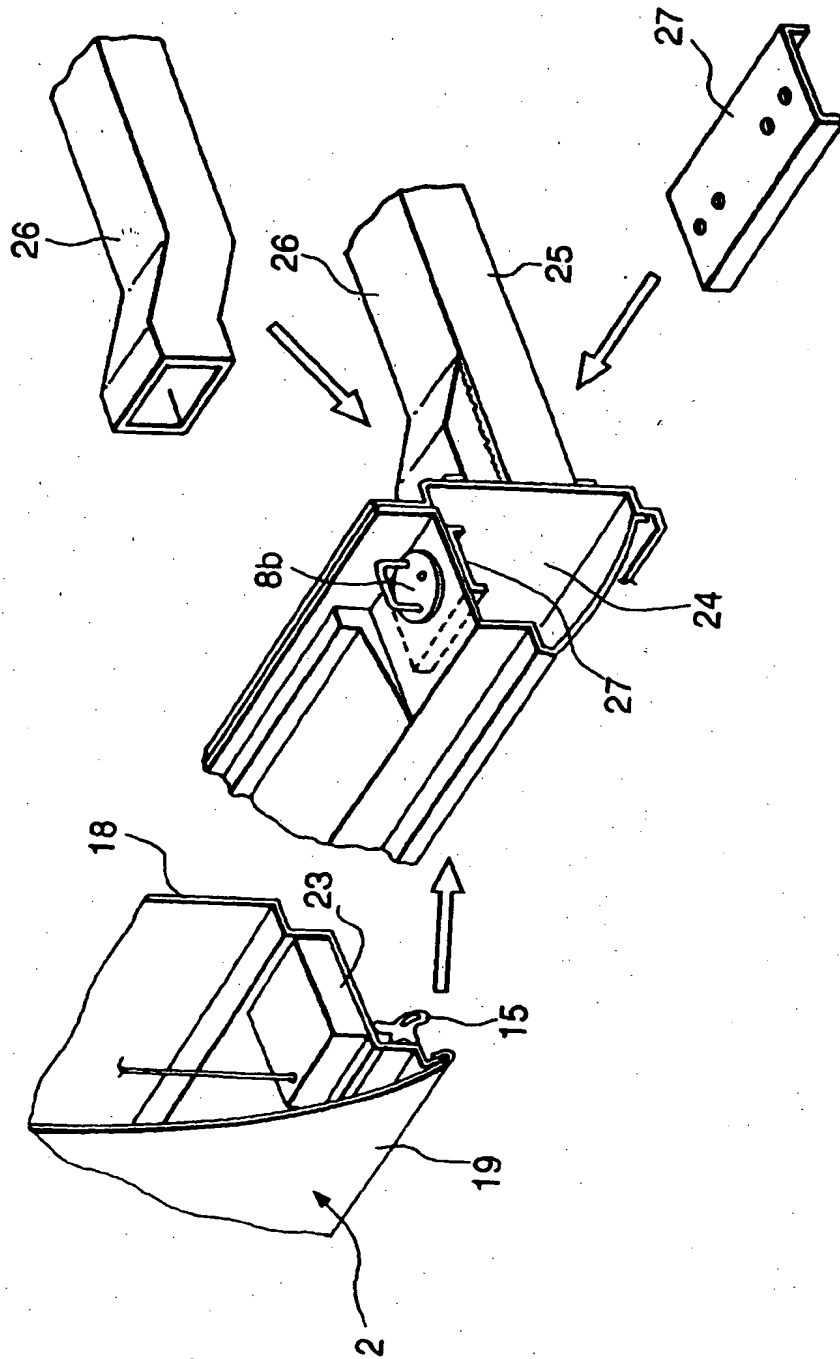


FIG. 12

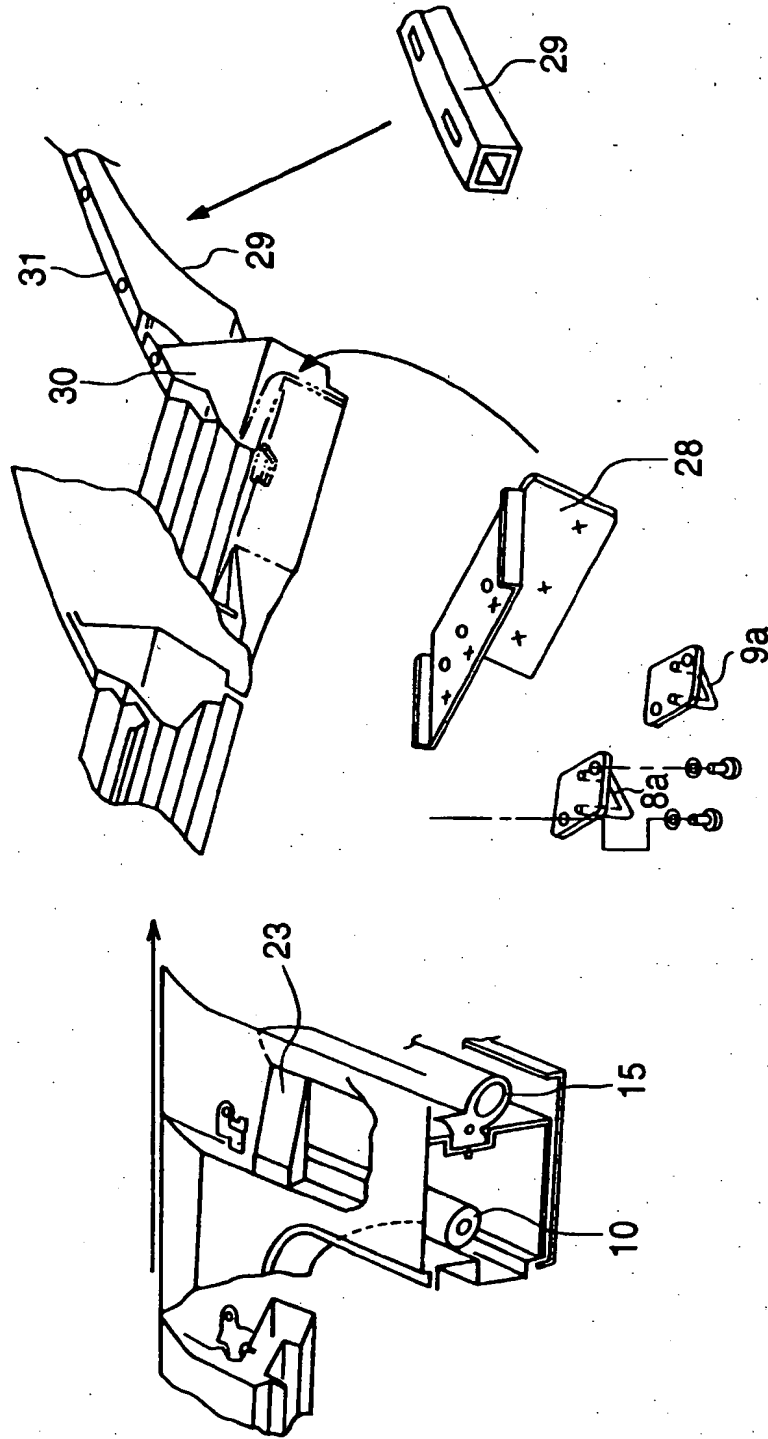
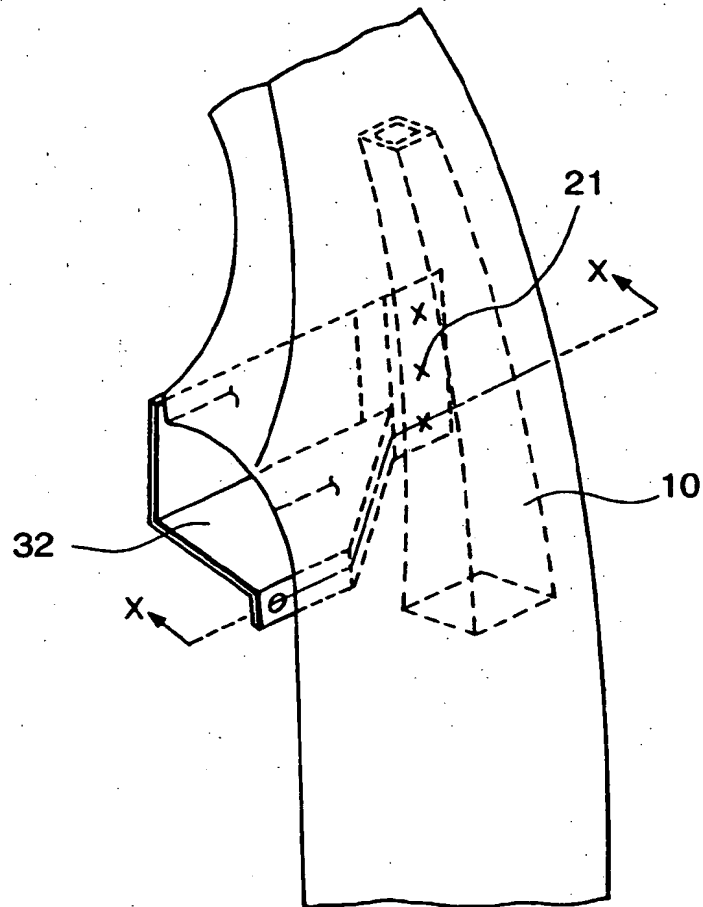


FIG. 14





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# EUROPEAN SEARCH REPORT

Application Number  
EP 00 11 1752

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 398 988 A (DELBERT D. DEREES ET AL.) 21 March 1995 (1995-03-21) * abstract * * column 1, line 52 - column 3, line 41; figures 1-3B *	1-7,11, 12	B60J5/04
X	US 1 639 037 A (ARTHUR J. HOLLINGSHEAD) 16 August 1927 (1927-08-16) * claim 1; figures 1-10 *	1,11	
X,P	US 6 059 352 A (GARY EUGENE HELDT ET AL.) 9 May 2000 (2000-05-09) * abstract *	1	
A	* column 1, line 38 - line 65; figures 1,2,6 *	2-7,11, 12	
A	EP 0 220 414 A (DR. ING.H.C. F. PORSCHE AKTIENGESELLSCHAFT) 6 May 1987 (1987-05-06) * abstract; claims 1-6; figure 1 *	1,11,12	
A	"Entre berline et monospace" REVUE AUTOMOBILE,CH,HALLWAG S.A. BERNE, vol. 89, no. 40, 29 September 1994 (1994-09-29), page 17 XP000466644 ISSN: 0035-0761 * page 17 *	1,11	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B60J
A,D	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 09, 31 July 1998 (1998-07-31) & JP 10 109662 A (MITSUBISHI MOTORS CORP), 28 April 1998 (1998-04-28) * abstract; figures 1-6 *	1-7,11, 12	
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 19 October 2000	Examiner Cuny, J-M
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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19-10-2000

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5398988	A	21-03-1995	NONE	
US 1639037	A	16-08-1927	NONE	
US 6059352	A	09-05-2000	NONE	
EP 0220414	A	06-05-1987	DE 3537304 A	23-04-1987
JP 10109662	A	28-04-1998	NONE	
DE 2414114	A	24-10-1974	US 3868796 A	04-03-1975
			CA 988124 A	27-04-1976
			GB 1437575 A	26-05-1976
			JP 973417 C	28-09-1979
			JP 49135321 A	26-12-1974
			JP 54007094 B	04-04-1979
JP 09150752	A	10-06-1997	BR 9702908 A	24-08-1999
			DE 19639895 A	03-04-1997
			ES 2144348 A	01-06-2000
			FR 2753676 A	27-03-1998
			GB 2305639 A,B	16-04-1997
			US 6022070 A	08-02-2000

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